Introduction

Six Sigma at Quest Diagnostics

The Six Sigma method was introduced in the 1980s, when Motorola pigneered

- · measure defects per million opportunities (DPMO) to provide a better understanding of defect rates and process performance
- · establish a new business culture that uses process-driven methodology

Literally, Six Sigma stands for 3.4 DPMO-virtual perfection. The Six Sigma business philosophy thus focuses on reducing overall defects and performance variation as defined by the "Voice of the Customer." The Quest Diagnostics Six Sigma program incorporates both Six Sigma and Lean principles and process tools to improve performance. Since 2000, more than 160 business leaders throughout Quest Diagnostics have become Black Belts (full-time Six Sigma project leaders). These Black Belts work with every Quest Diagnostics business unit and functional area across the company.

This report describes the implementation of Six Sigma methods to reduce the occurrence of "tests not performed" (TNP) for a client.

Business Case / Problem Statement

A major pediatric hospital client had an unacceptably high rate (2.2%) of test

- requests that could not be fulfilled. Reasons included:
- No specimen drawn

Analyze

Improvement

- · Wrong specimen drawn
- · Duplicate test ordered
- · Specimen quantity not sufficient

TNPs cause extra work for the submitting hospital and the performing laboratory More importantly, they might adversely affect patient care. The primary purpose of this Six Sigma project was to identify and remedy the underlying causes of the high TNP rate at this hospital. This process required close collaboration with hospital staff to ensure the flow of information and perspectives. An interesting and challenging aspect of this undertaking was that the hospital personnel involved had no previous exposure to Six Sigma methods.

Method

Overview of Six Sigma procedures used in this project

Establish the business case: the customer expectations (Voice of the Customer (VOC)); what is Critical To Quality (CTQ) to the customer; definition of primary metrics (Ys); defect definitions; identify the Suppliers, supplier Inputs, high level Process, process Output, Customers (SIPOC); and roles and responsibilities of team members

Measure Study and map the process steps; establish a data collection plan; assess capabilities of measurement systems; measure baseline performance of the process (Ys and defects); establish goals for defect reduction;

preliminary stratification of problems Identify the variables (Xs) that influence process

performance (process maps, FMEA, YX matrix, stratification graphs etc. establish and test hypothesis effects of variables (Xs) upon process (Ys); identify improvements improvements: create control chart to measure the

Innovative Perform cost-benefit analysis of improvements: pilot

improvement performance Control Establish a control plan for the process owner; document and standardize the improvements; continue to control chart monitor the improved process

Method (cont)

Six Sigma Team

Hospital: Clinic process experts (medical assistants LPNs): outpatient department (phlebotomist); and hospital laboratory control department Quest Diagnostics: Six Sigma Black Belt

- A high-level overview (Fig. 1) identified 3 main areas to focus our attention:
- Test ordering
- · Specimen collection
- Specimen preparation

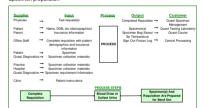
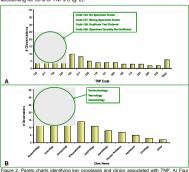


Figure 1. SIPOC (Supplier-Input-Process-Output-Customer) chart used to identify factors leading to TNP. This high-level process overview led the team to focus on test ordering specimen collection, and specimen preparation

Pareto charts identified 4 processes accounting for 50% of TNPs and 3 clinics. accounting for 55% of TNPs (Fig. 2).



process error types led to 50% of TNPs: B) Three clinics within the hospital accounted for

Method (cont)

The Six Sigma process also requires mapping of all steps and decisions in a process and establishment of key measures of performance for the process as defined by the SIPOC chart. Figure 3 shows an example of one of the process. mans used in this project.

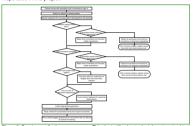


Figure 3. Specimen collection process map. This chart utilized outpatient department subject matter experts to document a detailed process map for specimen collection. Process maps such as this are valuable visualization tools that help team members identify possible causes of problems and potential areas for improvement. Numerous process mans were created

Analyze

Failure mode and effects analysis (FMEA)

FMEA is a powerful quality tool used to identify problem areas in processes and how these problems affect down-stream steps in the process. FMEA is helpful in prioritizing potential causes of process failure. We used FMEA to identify and assess the potential impact of failure areas in the sample submission process.

High-Level	Process Step/Input	Potential Failure Mode	Potential Failure Effects	S E V	Potential Causes	000	Current Controls	D E +	P N
What is the process slep! Input under investigation?		In what ways does the Key Input go wrong?	What is the impact on the Key Output Variables (Customer Requirements) or internal requirements?	Housevere is the effect to the customer?	What causes the Key Input to go wrong?	5	(inspection and test) that prevent either the cause or the failure	How well can you deted	Risk priority number
Test Ordering & Specimen Collection	Clinic has an internal form the doctor uses for national visit	NA						Г	
Test Ordering & Specimen Collection	The internal form has an area for routine tests to be ordered by checking off. Also has an area to hand write test orders.	Ordering wrong test	No results on test needed	6	Human error	2		10	120
Test Ordering & Specimen Collection	The internal form has an area for routine tests to be ordered by checking off. Also has an area to hand write test orders.	Missing a test	No results on test needed	ь	Human error	2	Ordering guides by age	1	12
Test Ordering & Specimen Collection	Testing is ordering where a patient is scheduled for blood work without a doctor visit. Doctor got original results and needs additional testino.	N/A							0
Test Ordering & Specimen Collection	An RN, LPN or MA enters the request in the Quest TOROL system with patient demographics, insurance information and test orders from the internal form.	Ordering wrong test	No results on test needed	6	Understanding the hand- writing	5	Procedure to review before printing out	5	150
Test Ordering & Specimen Collection	An RN, LPN or MA enters the request in the Quest TOROL system with patient demographics, insurance information and test orders from the internal form.	Ordering wrong test	No results on test needed	6	Doctor order is not specific (HIV)	2	Procedure to review before printing out	5	60

Figure 4. Failure mode and effects analysis (FMEA) chart. This truncated chart is for illustrative numbers only. The actual EMEA chart developed for this projects contains 222HOW MANY222 rows of data. The full FMFA chart also contains columns for follow up of severity, occurrence, detectability, and RPN after corrective actions are taken. The RPN (risk priority number) is the product of the severity occurrence frequency, and detectability, each of which is scored on a scale of 1-10.

Method (cont)

Innovative Improvement

To address the problems identified above, we implemented the Quest Care 360. Electronic Test Ordering System. The key benefits of this system are outlined

- . Up-to-date test ordering database
- · Printed requisition eliminates errors caused by hand-writing
- . Client/patient database reduces demographic and billing errors
- . Up-to date test database with preferred and alternate specimen requirements
- · User friendly customized test ordering panels
- · Requisitions indicate preferred specimen and storage temperature
- · Several customized report management options
- · Electronic technical up-dates
- · Electronic ordering eliminating keving errors

In addition, a "Doctor Order" form specific to each clinic was created to eliminate the effects of handwriting errors (Fig. 5). The test selection on the form was determined by the current usage with review and additions through key clinic

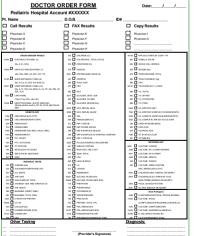


Figure 5. Electronic "Doctor Order" form.

Results (cont)

Implementation of the Quest Care 360 Electronic Test Ordering System resulted in a 50% reduction on the frequency of TNP reports (Fig. 5).

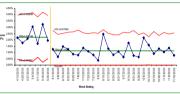


Figure 6. TNP control chart showing reduction in TNP after implementation of the Quest Care 360 Flectronic Test Ordering System, CEN, center line: LICL upper control limit; LCL lower control limit. Vertical har indicates installation and initiation of the Care 360 statem

A control plan has been implemented to ensure that the TNP rate remains within reasonable limits (Figure 7).



Diagnostics and the hospital

Conclusions

- . The six sigma methods employed in this project allowed us to
 - . Identify the sources of errors leading to the high rate of TNP
 - · Implement effective interventions to correct the errors
 - . Monitor the success of these interventions and quickly recognize recurrence of the problem
- Black belt projects can be successfully implemented even in environments with no previous exposure to six sigma method:
- The close collaboration between the Quest Diagnostics and hospital staff required by this project provided a valuable opportunity for each to see firsthand the challenges faced by the other
- The six-sigma tools used to identify the sources of error leading to TNP helped focus attention on all